

# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : CITIZEN WATCH CO LTD

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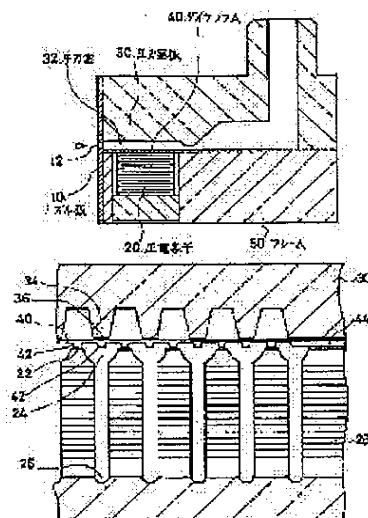
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## (54) INK JET HEAD

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To ensure adhesive and sealing properties even when the width of the top part of a partition of a pressure room is narrowed and to prevent pressure from leaking to the adjoining pressure room by dividing a piezoelectric element into a plurality of parts by the first wide and shallow channels and the second narrow and deep channels.

**SOLUTION:** A diaphragm 40 has an island 42 being an island-like thick part and the number of these islands is two-fold of pressure rooms 32 of a pressure room plate 30. The apex part of the even numbered island 42 is bonded to the free end part 22 of a piezoelectric element 20 and the back face of the odd numbered island 42 is bonded to the top part 36 of the partition 34 of a pressure room plate. The piezoelectric element 20 is divided into a plurality of parts by the first wide and shallow channels 24 and the second narrow and deep channels each with the same axial line as this channel 24. Practically, channel processing is performed by means of a wire saw in such a way that the first wide and shallow channels 24 with a channel width of approximately  $100\mu\text{m}$  are processed by using a thick wire with a diameter of approximately  $90\mu\text{m}$ . Strong tension is applicable to the thick wire to process a precise channel position.



## LEGAL STATUS

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CLAIMS

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[Claim(s)]

[Claim 1] The nozzle plate which has two or more nozzle holes which carry out the regurgitation of the ink The pressure room board which is mostly divided into the same number with the number of nozzles, has a slot on the same number mostly with the piezoelectric device which is the energy source of supply of the ink regurgitation, and the number of nozzles, and makes this a pressure room, and the island which is an island-like heavy-gage part The number of the islands which are the ink-jet heads equipped with the above, and are the island-like heavy-gage parts of a diaphragm is the number of double precision of the pressure room of a pressure room board. The point of the island of No. even joins to the crowning of a piezoelectric device, the tooth back of the island of No. odd joins to the crowning of a pressure room board septum, and width of face is characterized by dividing into plurality by the second narrow deep slot on the axis as the first large shallow slot and the first slot with the width of face same [ a piezoelectric device ].

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to improvement of an ink-jet head.

[0002]

[Description of the Prior Art] The conventional diaphragm has prepared the piezoelectric device divided into plurality, and the island which is the island-like heavy-gage part of the same number. The island of a diaphragm counters with the free edge of a piezoelectric device, and is joined. The crowning of a pressure room board septum joins the thin-walled part of a diaphragm.

[0003] Junction of a pressure room board and a diaphragm presses a diaphragm, after applying adhesives to the crowning of a pressure room board septum. Since the crowning of a pressure room board septum has countered the thin-walled part of a diaphragm, it is the composition that the press force does not fully join the adhesives between the crowning of a pressure room board septum, and a diaphragm.

[0004] The thickness nonuniformity by application produces adhesives. The thickness nonuniformity of adhesion becomes the factor which checks the adhesion sealing performance of a pressure room board and a diaphragm. It is important for reduction of thickness nonuniformity to apply the press force to a pressure room board and a diaphragm, to press adhesives, and to reduce irregularity. When the interval of a pressure room was also fully able to secure the width of face of the crowning of a pressure room septum widely, even if it was the conventional composition, the adhesion sealing performance of the crowning of a pressure room septum and a diaphragm has been secured mostly.

[0005] These days, the request of high-resolution-izing which raises picture quality is strong. The embodiment of this request is increasing the number of pressure rooms which narrows the interval of a pressure room and is prepared in a unit length. In connection with a pressure room interval serving as half [conventional], the width of face of a septum crowning also serves as abbreviation half.

[0006] If width of face of a septum crowning is made into an abbreviation half and it pastes up with the conventional composition, adhesion sealing performance is not securable with the irregularity of the adhesives which remain slightly. Consequently, the pressure leakage by the contiguity pressure room arose, and there was a fault to which an ink discharging performance falls.

[0007] Moreover, the number of partitions of a piezoelectric device also increases with high-resolution-izing. In order to obtain predetermined driving force, fixed width of face is required for the land width of a piezoelectric device. Therefore, remarkable flute width reduction is required for increase of the number of partitions of a piezoelectric device.

[0008] Recessing is performed by the wire saw. Although a narrow wire is used for \*\*\*\*\*, since it is easy to disconnect a narrow wire, it cannot apply high tension. For this reason, a wire interval tends to be influenced of few blemishes of the piezoelectric device in the time of contacting a piezoelectric device, a chip, etc. Therefore, in \*\*\*\*\*, there was a fault to which gap of a slot position becomes large.

[0009]

[Problem(s) to be Solved by the Invention] The purpose of \*\*\*\* is being able to secure adhesion sealing performance, even if the width of face of the crowning of a pressure room septum becomes narrow, and abolishing the pressure leakage by the contiguity pressure room. Furthermore, in processing of the narrow slot accompanying increase of the number of partitions of a piezoelectric device, it is the thing which secure slot position precision and to do for thing reservation. It is attaining the demand which increases the number of pressure rooms prepared in a unit length, and replying to the request of high-resolution-izing of an ink-jet head by both purpose achievement.

[0010]

[Means for Solving the Problem] The nozzle plate which has two or more nozzle holes which carry out the regurgitation of the ink in order to solve the above-mentioned technical problem, The piezoelectric device which it is mostly divided into the same number with the number of nozzles, and is the energy source of supply of the ink regurgitation, It has the pressure room board which has a slot on the same number mostly with the number of nozzles, and makes this a pressure room, and the diaphragm which has the island which is an island-like heavy-gage part. It is the ink-jet head which tells the variation rate of a piezoelectric device to the ink of the pressure interior of a room by forming a pressure room by joining a pressure room board and a diaphragm, and joining a diaphragm and a piezoelectric device. The number of the islands which are the island-like heavy-gage parts of a diaphragm is the number of double precision of the pressure room of a pressure room board. The point of the island of No. even joins to the crowning of a piezoelectric device, the tooth back of the island of No. odd joins to the crowning of a pressure room board septum, and width of face divides into plurality by the first slot where a piezoelectric device is large and it is shallow, and the second deep slot where width of face is narrow.

[0011]

[Embodiments of the Invention] Drawing 1 is the cross section showing one example of the ink-jet head in connection with this invention. A nozzle plate 10 has two or more nozzle holes 12 which carry out the regurgitation of the ink. A piezoelectric device

20 is the energy source of supply of the ink regurgitation, and is mostly divided into the same number by recessing in nozzle more than and a hole 12. The pressure room board 30 has a slot on the same number mostly in nozzle more than and a hole 12, and forms the pressure room which is also ink passage.

[0012] In drawing 3, a diaphragm 40 has the island 42 which is an island-like heavy-gage part. The number of the islands 42 of a diaphragm 40 prepares the number of double precision of the pressure room 32 of the pressure room board 30. The point of the island 42 of No. even is joined to the free edge 22 of a piezoelectric device 20, and the tooth back of the island 42 of No. odd is joined to the crowning 36 of the pressure room board septum 34.

[0013] The piezoelectric-device flank 28 is formed in the both-sides section of a piezoelectric device 20, and the diaphragm flank 44 which is a heavy-gage part is formed also in the both-sides section of a diaphragm 40.

[0014] The pressure room board 30 forms the pressure room 32 by joining a diaphragm 40. After junction of the pressure room board 30 and a diaphragm 40 applies an epoxy adhesive by screen printing or the imprint method, where the pressure room board 30 and a diaphragm 40 are pressed, it is heated and hardened.

[0015] The island 42 is formed corresponding to the crowning 36 of the pressure room board 30, and since each island 42 is the almost same height, the above-mentioned press force also fully joins the adhesives between a crowning 36 and an island 42, and can secure positive adhesion sealing performance.

[0016] A frame 50 is joined to the pressure room board 30 after junction of a diaphragm 40. The junction method of a frame 50 applies an epoxy adhesive to a frame 50 by screen printing or the imprint method, and pressurizes the pressure room board 30 and a frame 50 in the state of pinching a diaphragm 40. It heats after that and adhesives are stiffened.

[0017] The same field is made to the field which joins a nozzle plate 10 after the pressure room board 30, the diaphragm 40, and the frame 50 have been united. A nozzle plate 10 is joined to the finished surface. Junction of a nozzle plate 10 applies an epoxy adhesive to the crowning 36 of the pressure room board 30 by screen printing or the imprint method, and carries out heat hardening of the nozzle plate 10 in the state of the bottom of press.

[0018] It joins to an island 42 and the free edge 22 of a piezoelectric device 20, and a diaphragm 40 tells the variation rate of a piezoelectric device 20 to the ink of the pressure interior of a room.

[0019] Junction of the free edge 22 of a diaphragm 40 and a piezoelectric device 20 applies an epoxy adhesive to the free edge 22 and the piezoelectric-device flank 28 by screen printing or the imprint method, and presses it to the diaphragm 40 joined to the pressure room board 30. Simultaneously, since adhesives are applied, pressed and hardened also to the piezoelectric-device flank 28, the piezoelectric-device flank 28 and the diaphragm flank 44 are also joined.

[0020] The second slot 26 where width of face is narrow and deep is dividing the piezoelectric device 20 into plurality on the same axis as the first slot 24 where width of face is wide and shallow, and the first slot. Recessing by the wire saw is performed in this example. First, the first large shallow slot 24 with a flute width of about 100 micrometers is processed using a thick wire with a diameter of about 90 micrometers. Since strong tension is applied, a thick wire is not influenced by few surface irregularity or chips of a piezoelectric device 20, but an exact slot position is possible for it.

[0021] Next, the second narrow deep slot 26 with a flute width of about 50 micrometers is processed using a narrow wire with a diameter of about 40 micrometers. A narrow wire position is set up according to the center section of the first slot 24. Since a narrow wire is guided in the first slot 24, an exact slot position is obtained.

[0022] Moreover, since there is the first slot 24 even if it is the case where the position gap at the time of junction to a piezoelectric device 20 and a diaphragm 40 arises, the island 42 of an odd number can prevent mechanical contact at the free edge 22 of a piezoelectric device 20.

[0023]

[Effect of the Invention] According to this invention, adhesives can be certainly pressed by the tooth back of the island of No. odd, and the crowning of a pressure room board septum. By this, even if the width of face of the crowning of a pressure room board septum is narrow, adhesives application nonuniformity is homogenized by the positive press force, and the adhesion sealing performance of the crowning of a pressure room board septum and a diaphragm can be secured.

[0024] Moreover, according to this invention, since width of face divides a piezoelectric device into plurality by the first large and shallow slot and the second slot where width of face is narrow and deep, a high slot position precision is acquired. Furthermore, prevention can perform the contact to a piezoelectric device and the diaphragm of an odd number by the size effect of the first slot where width of face is wide and shallow, and the number of piezoelectric devices prepared in a unit length can be made [ many ]. The increase in the number of pressure rooms prepared in the unit length which narrowed the pressure room interval by this can be attained.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the main cross section showing one example of the ink-jet head concerning this invention.

[Drawing 2] It is the level partial vertical cross section of this example.

[Drawing 3] It is the important section cross section of this example.

[Description of Notations]

10 Nozzle Plate

20 Piezoelectric Device

30 Pressure Room Board

40 Diaphragm

50 Frame

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JP9-277,527A

DERWENT-ACC-NO: 1998-013657

DERWENT-WEEK: 199802

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TITLE: Ink jet head for printers - has groove whose  
width is varied based on number of surrounding parts

PATENT-ASSIGNEE: CITIZEN WATCH CO LTD[CITL]

PRIORITY-DATA: 1996JP-0095422 (April 17, 1996)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
PAGES MAIN-IPC		
JP 09277527 A	October 28, 1997	N/A
B41J 002/045		004

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO
APPL-DATE		
JP 09277527A	N/A	1996JP-0095422
April 17, 1996		

INT-CL (IPC): B41J002/045, B41J002/055

ABSTRACTED-PUB-NO: JP 09277527A

BASIC-ABSTRACT:

- / The head includes a nozzle plate (10) with a set of nozzles for discharging ink and a piezoelectric element (20) supplies energy for the ink discharge.
- A
- 5 pressure chamber plate (30) has a set of grooves equal to the number of nozzles and a diaphragm (4) with a thick convex shaped surrounding part. A pressure chamber is formed by the junction of pressure chamber plate and the
- 10 diaphragm. The piezoelectric element displaces ink to the interior pressure chamber by the junction of diaphragm and piezoelectric element. The junction is formed at the
- 15 top part of piezoelectric element and pressure chamber plate based on the number of surrounding parts. The width of groove varies on the same axle line according to the number of surrounding parts.
- 20 ADVANTAGE - Provides uniform adhesive coating by applying reliable pressure.

22 Secures effective bonding. Increases groove position accuracy.

CHOSEN-DRAWING: Dwg.1/3

TITLE-TERMS: INK JET HEAD PRINT GROOVE WIDTH VARY BASED NUMBER SURROUND  
PART

DERWENT-CLASS: P75 T04 V06

EPI-CODES: T04-G02A; V06-M06D; V06-U04B;

SECONDARY-ACC-NO:

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B 4 1 J	2/045		B 4 1 J	3/04
	2/055			1 0 3 A
				1 0 3 C

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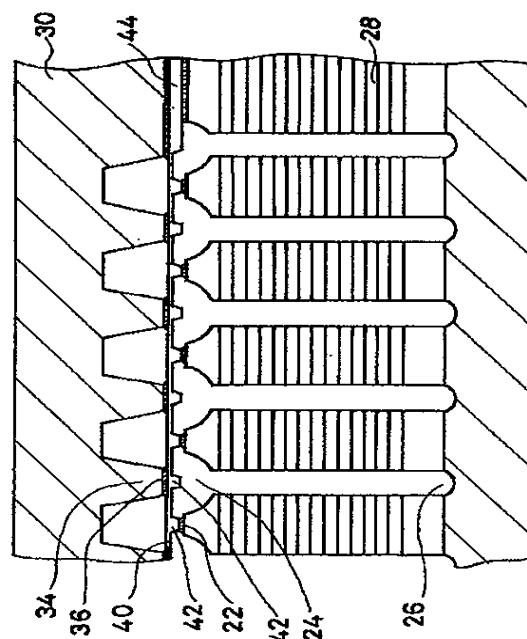
チズン時計株式会社技術研究所内

(54)【発明の名称】 インクジェットヘッド

(57)【要約】

【課題】圧力室隔壁の接着密封性の確保と、圧電素子の溝加工位置精度を確保とにより、単位長さ内に設ける圧力室数を増加する事で高解像度インクジェットヘッドを提供する。

【解決手段】ダイヤフラムのアイランド数が圧力室板の圧力室の2倍数であり、偶数番のアイランドの先端部が圧電素子の頂部に接合し、奇数番のアイランドの背面が圧力室板隔壁の頂部に接合する。圧電素子が、幅が広く浅い第一の溝と、幅が狭く深い第二の溝とにより、複数に分割する。すると、圧力室板隔壁の頂部とダイヤフラムとの接着密封性が確保でき、圧電素子の溝位置精度が高める事ができ、圧電素子とアイランドとの当接が防止ができる。この結果、単位長さ内に設ける圧力室数の増加を達成できる。





## 【特許請求の範囲】

【請求項1】 インクを吐出する複数のノズル穴を有するノズル板と、ノズル数とほぼ同数に分割されインク吐出のエネルギー供給源である圧電素子と、ノズル数とほぼ同数の溝を有しここを圧力室とする圧力室板と、島状厚肉部であるアイランドを有するダイヤフラムとを有し、

圧力室板とダイヤフラムとを接合することで圧力室を形成し、ダイヤフラムと圧電素子とを接合する事で圧電素子の変位を圧力室内のインクに伝えるインクジェットヘッドであって、ダイヤフラムの島状厚肉部であるアイランドの数が圧力室板の圧力室の2倍数であり、偶数番のアイランドの先端部が圧電素子の頂部に接合し、奇数番のアイランドの背面が圧力室板隔壁の頂部に接合し、圧電素子が、幅が広く浅い第一の溝と、第一の溝と同一軸線上で幅が狭く深い第二の溝とにより、複数の分割している事を特徴とするインクジェットヘッド。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、インクジェットヘッドの改良に関する。

## 【0002】

【従来の技術】従来のダイヤフラムは、複数の分割された圧電素子と同数の島状厚肉部であるアイランドを設けてある。ダイヤフラムのアイランドは、圧電素子の自由端部と対向し接合する。ダイヤフラムの薄肉部は、圧力室板隔壁の頂部が接合する。

【0003】圧力室板とダイヤフラムの接合は、圧力室板隔壁の頂部に接着剤を塗布した後にダイヤフラムを押圧する。圧力室板隔壁の頂部はダイヤフラムの薄肉部に対向しているため、圧力室板隔壁の頂部とダイヤフラムとの間の接着剤に押圧力が十分に加わらない構成である。

【0004】接着剤は、塗布による厚さムラが生じる。接着の厚さムラは、圧力室板とダイヤフラムとの接着密封性を阻害する要因となる。厚さムラの低減には、圧力室板とダイヤフラムに押圧力を加え、接着剤を押圧し凹凸を低減する事が重要である。圧力室の間隔が広く圧力室隔壁の頂部の幅も十分に確保できる場合には、従来の構成であっても圧力室隔壁の頂部とダイヤフラムとの接着密封性は、ほぼ確保できた。

【0005】近来、画像品質を高める高解像度化の要望が強い。この要望の具現化は、圧力室の間隔を狭め、単位長さ内に設ける圧力室数を増加する事である。圧力室間隔が従来の半分となるのに伴い、隔壁頂部の幅も約半分となる。

【0006】従来の構成のままで、隔壁頂部の幅を約半分とし接着すると、わずかに残る接着剤の凹凸により接着密封性を確保できない。この結果、隣接圧力室への圧

力漏れが生じ、インク吐出性能が低下する欠点があった。

【0007】また、高解像度化に伴い圧電素子の分割数も増大する。圧電素子のランド幅は、所定の駆動力を得るため一定の幅が必要である。従って圧電素子の分割数の増大は、著しい溝幅低減が必要である。

【0008】溝加工はワイヤーソーで行う。狭溝加工には細いワイヤーを用いるが、細いワイヤーは断線しやすいため高い張力を加える事が出来ない。このためワイヤー間隔は、圧電素子と接触した時点での圧電素子の僅かな傷や欠け等の影響を受けやすい。従って、狭溝加工では溝位置のズレが大きくなる欠点があった。

## 【0009】

【発明が解決しようとする課題】本案の目的は、圧力室隔壁の頂部の幅が狭くなっても接着密封性を確保でき、隣接圧力室への圧力漏れを無くす事である。更に、圧電素子の分割数の増大に伴う幅狭溝の加工において、溝位置精度を確保するの確保する事である。両者の目的達成により、単位長さ内に設ける圧力室数を増加する要求を達成し、インクジェットヘッドの高解像度化の要望に答える事である。

## 【0010】

【課題を解決するための手段】上記課題を解決するため、インクを吐出する複数のノズル穴を有するノズル板と、ノズル数とほぼ同数に分割されインク吐出のエネルギー供給源である圧電素子と、ノズル数とほぼ同数の溝を有しここを圧力室とする圧力室板と、島状厚肉部であるアイランドを有するダイヤフラムとを有し、圧力室板とダイヤフラムとを接合することで圧力室を形成し、ダイヤフラムと圧電素子とを接合する事で圧電素子の変位を圧力室内のインクに伝えるインクジェットヘッドであって、ダイヤフラムの島状厚肉部であるアイランドの数が圧力室板の圧力室の2倍数であり、偶数番のアイランドの先端部が圧電素子の頂部に接合し、奇数番のアイランドの背面が圧力室板隔壁の頂部に接合し、圧電素子が、幅が広く浅い第一の溝と、幅が狭く深い第二の溝とにより、複数の分割する。

## 【0011】

【発明の実施の形態】図1は本発明にかかわるインクジェットヘッドの一実施例を示す断面図である。ノズル板10は、インクを吐出する複数のノズル穴12を有する。圧電素子20は、インク吐出のエネルギー供給源であり、ノズル穴12数とほぼ同数に溝加工により分割されている。圧力室板30はノズル穴12数とほぼ同数の溝を有し、インク流路でもある圧力室を形成する。

【0012】図3において、ダイヤフラム40は、島状厚肉部であるアイランド42を有する。ダイヤフラム40のアイランド42の数は、圧力室板30の圧力室32の2倍数を設ける。偶数番のアイランド42の先端部は圧電素子20の自由端部22に接合し、奇数番のアイラ

ンド42の背面は圧力室板隔壁34の頂部36に接合する。

【0013】圧電素子20の両側部には圧電素子側部28が設けてあり、ダイヤフラム40の両側部にも厚肉部であるダイヤフラム側部44が設けてある。

【0014】圧力室板30は、ダイヤフラム40を接合する事で圧力室32を形成する。圧力室板30とダイヤフラム40の接合は、スクリーン印刷法や転写方法でエポキシ接着剤を塗布した後、圧力室板30とダイヤフラム40を押圧した状態で加熱し硬化する。

【0015】圧力室板30の頂部36に対応してアイランド42を設けてあり、それぞれのアイランド42はほぼ同じ高さであるので、上記押圧力は頂部36とアイランド42の間の接着剤にも十分に加わり、確実な接着密封性が確保できる。

【0016】圧力室板30とダイヤフラム40の接合後、フレーム50を接合する。フレーム50の接合方法は、フレーム50にスクリーン印刷法や転写方法でエポキシ接着剤を塗布し、ダイヤフラム40を挟む状態で圧力室板30とフレーム50を加圧する。その後に加熱し接着剤を硬化させる。

【0017】圧力室板30とダイヤフラム40とフレーム50が一体となった状態で、ノズル板10を接合する面を同一面に仕上げる。その仕上面に、ノズル板10を接合する。ノズル板10の接合は、圧力室板30の頂部36にエポキシ接着剤をスクリーン印刷法や転写方法で塗布し、ノズル板10を押圧下状態で加熱硬化する。

【0018】ダイヤフラム40は、アイランド42と圧電素子20の自由端部22と接合し、圧電素子20の変位を圧力室内のインクに伝える。

【0019】ダイヤフラム40と圧電素子20の自由端部22の接合は、自由端部22と圧電素子側部28にエポキシ接着剤をスクリーン印刷法や転写方法で塗布し、圧力室板30に接合されたダイヤフラム40に押圧する。同時に、圧電素子側部28にも接着剤を塗布し押圧し硬化するので、圧電素子側部28とダイヤフラム側部44も接合される。

【0020】圧電素子20は、幅が広く浅い第一の溝24と、第一の溝と同一軸線上で幅が狭く深い第二の溝26とにより、複数に分割している。本実施例では、ワイ

ヤーソーによる溝加工を行っている。まず、直径約90 $\mu$ mの太いワイヤーを用い溝幅約100 $\mu$ mの広く浅い第一の溝24を加工する。太いワイヤーは強い張力が加えられるので、圧電素子20の表面のわずかな凹凸や欠けに影響されず、正確な溝位置が可能である。

【0021】次に、直径約40 $\mu$ mの細いワイヤーを用い溝幅約50 $\mu$ mの狭い深い第二の溝26を加工する。細いワイヤー位置は、第一の溝24の中央部に合わせて設定する。細いワイヤーは第一の溝24に案内されるので、正確な溝位置が得られる。

【0022】また、圧電素子20とダイヤフラム40との接合時の位置ズレが生じた場合であっても、第一の溝24が有るため、奇数番号のアイランド42は圧電素子20の自由端部22との機械的な当接を防止できる。

【0023】

【発明の効果】本発明によれば、奇数番のアイランドの背面と圧力室板隔壁の頂部とにより接着剤を確実に押圧できる。これにより、圧力室板隔壁の頂部の幅が狭くても接着剤塗布ムラを確実に押圧力で均質化し、圧力室板隔壁の頂部とダイヤフラムとの接着密封性が確保できる。

【0024】また、本発明によれば、圧電素子を幅が広く浅い第一の溝と幅が狭く深い第二の溝とにより複数に分割するので、高い溝位置精度が得られる。更に、幅が広く浅い第一の溝の形状効果により圧電素子と奇数番号のダイヤフラムとの当接が防止ができ、単位長さ内に設ける圧電素子数を多くすることが出来る。これにより圧力室間隔を狭めた単位長さ内に設ける圧力室数の増加を達成できる。

【図面の簡単な説明】

【図1】本発明に係わるインクジェットヘッドの一実施例を示す主要断面図である。

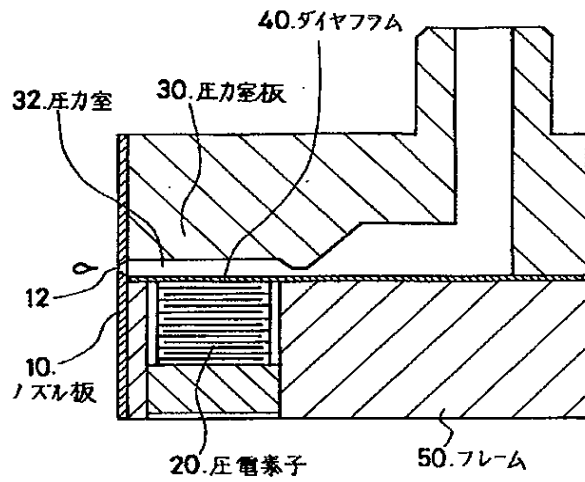
【図2】本実施例の水平部分垂直断面図である。

【図3】本実施例の要部断面図である。

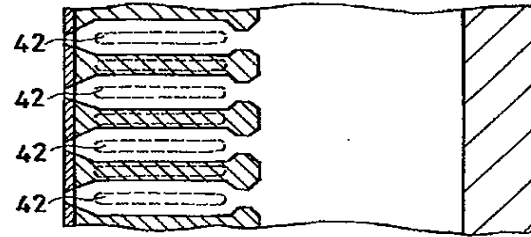
【符号の説明】

- 10 ノズル板
- 20 圧電素子
- 30 圧力室板
- 40 ダイヤフラム
- 50 フレーム

【図1】



【図2】



【図3】

